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EMG PRESENTATION

GRNS MEETING
U.S. DOE
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CONTENTS

- *General discussion on status of EMG activities*

- *Discussion of individual activities and issues being addressed by EMG*

Status of EMG Activities

- *Final Screening Document, Version 2, released Dec. 20, 2001*
  - *Version incorporated the EMG response to TWG/RIT/GRNS comments*
  - *Version did not contain guidance on R&D Prioritization*
  - *Release included version 2 of the electronic evaluation form*

- *Interactions with RIT, CGs in early January raised the following issues to be addressed by EMG*
  - *Consistency of scores after first draft evaluation*
  - *Consideration of alternative energy products*
  - *Definition of Development Costs*
  - *Refined guidance on selection (R&D Challenge)*
  - *Provide guidance on R&D Prioritization*
  - *Effect of the evaluation method on the system scores at the goal area level*
- *EMG currently addressing these issues*

Status of EMG Activities (cont'd)

- *Version 2.1 and 2.1a of the software has been distributed to TWGs for their use on the version 2 of the scores*
  - *Version 2.1 includes additional printing capabilities requested by the TWGs*
  - *Version 2.1a corrects a calculation error in SU-2*

- *Next (final) release - V.3 - of the Final Screening document and software due March 4*

- *EMG has initiated discussions on methodology for future evaluations*

SPECIFIC EMG ISSUES

Final Screening Comments from TWGs

- *The EMG collected and compiled all comments to the draft FS document from the TWGs, RIT, and GRNS*
- *The EMG addressed the comments during the San Francisco meeting*
- *A single table with all the comments and the resolution is being assembled*
- *The table will be ready soon and it will be distributed to the TWGs*

Generation of Alternative Energy Products

- *The EMG had been asked to further consider the apparently better suitability of some systems to generate energy products (hydrogen in particular) in addition to electricity.*
  - *It had also been suggested that an additional criterion should be added recognizing specific system suitability for alternative energy products, in particular related to carbon emissions avoidance*
- *The EMG discussed this issue at its January 10-11 meeting. Resolution:*
  - *Hydrogen (alternative products) is addressed in the Profitability criterion (guidance on pricing may be provided)*
  - *In principle, all systems could produce hydrogen; some systems may be able to generate hydrogen more efficiently (high T systems).*
  - *A simple additional criterion rewarding high T systems involves assumption of desirability of hydrogen (alternative energy product) over electricity, but ignores complete implications of generating the alternative energy product: full economic impact on facilities, production, impact on safety, reliability.*
  - *An additional criterion for alternative energy products will not be developed for the Final Screening*
- *If a system is proposed for primarily hydrogen production, the entire system should be evaluated as any other system, against all criteria.*

Development Costs

- *There had been some confusion regarding the inclusion/exclusion of the costs of a prototype or demonstration plant in the development costs*
- *This item was discussed within the EMG and then between the RIT and the EMG; it was agreed that there is no inconsistency in the FS documentation:*
  - *Development Costs – the development costs, as used in the first step of the system selection, are intended to represent the total cost to society of developing the system. Therefore, these costs should include, if applicable, the cost of a prototype facility, as specified in the FS document and in the ORNL cost methodology quoted.*
  - *R&D Challenge – R&D costs are included in the R&D Challenge in the second step of the selection process. The costs to the R&D-sponsoring entities are relevant here, but commercialization is beyond consideration. Therefore, costs of a prototype are not to be included; costs up to the preparation for the design certification are included in the R&D Challenge.*

R&D Challenge - Current thoughts

- *The basic information recommended for use in system selection process: (1) a measure of system potential and (2) a measure of development difficulty. The R&D Challenge is the figure of merit to express the degree of difficulty in developing a system.*
- *The R&D Challenge needs to be consistent with the R&D Questionnaire that the TWGs will complete for each system, on the basis of the identified technology gaps*
- *The R&D Questionnaire currently includes the following information for the R&D items:*
  - *Technology Readiness Level (TRL)*
  - *Cost range*
  - *Schedule*
  - *Likelihood of success*
  - *Relevance of the R&D to the system potential at a goal or goal area level*
- *The R&D Challenge in the current version (version 2) of the FS document will be updated to be consistent with the information collected in the R&D Questionnaire.*
- *Software will be developed to maintain the R&D Questionnaire information in electronic form and to evaluate the R&D Challenge for use in the second step of the selection process.*
- *The modified R&D Challenge and the software will be ready for the FS version3, March 4*

***CONCERN** - Lack of support in TWGs for a figure of merit for R&D Challenge*

R&D Challenge - R&D Costs

- *The TWGs will provide a cost estimate for each of the R&D items identified to close the technology gaps associated with a system*
- *The TWGs will provide a distribution for the R&D costs by specifying the costs corresponding to the most likely, least favorable and most favorable R&D innovation pathways for each R&D item*
  - *The lower limit result (most desirable outcome, lowest cost) will be obtained by assuming that the most favorable R&D result is obtained in the initial stage of R&D.*
  - *The higher limit result (least desirable outcome, highest cost) is obtained by assuming that the least favorable R&D result is obtained in the initial stage of R&D and that a subsequent R&D campaign is mounted in order to obtain satisfactory performance*
- *A scale will be provided for the TWGs to enter the range of R&D costs*
- *An expected cost will be estimated using the cost and the likelihood of success of the R&D provided by the TWGs - basic figure of merit for R&D Challenge*

R&D Challenge - Schedule and Relevance

- *The TWGs provide, in the Questionnaire, the minimum schedule required to complete each R&D item*
- *The difficulty in developing a particular technology - R&D challenge - will be affected by the schedule of the necessary R&D items.*
- *The R&D challenge figure of merit will account (provide a penalty) for those items whose schedule exceeds that desirable for the completion of the viability and performance R&D phases*
- *Each R&D item is assigned a relevance:*
  - *important to the viability of the system, its performance, or relevant to design optimization*
- *Items relevant to the viability of a system add to the uncertainty about the successful development of a system under cost and schedule constraints.*
- *The R&D challenge figure of merit will account (provide a penalty) for those items with larger numbers of viability issues*

R&D Challenge - R&D End Points

- *The R&D phases have been divided into Viability R&D and Performance R&D. The End Points (definition of the desired technology readiness level) for these two research phases need to be well established in order to properly account for the correct R&D costs and schedules*
- *The End Points are also needed to determine the system information that will be available in order to perform the evaluations after each of the R&D Phases*
- *The proposed end points and information available for the 2 R&D phases are as follows:*
- *Viability Phase - Basic concepts, technologies and processes proven at relevant conditions; potential technical show-stoppers identified and resolved*
  - *Conceptual design of nuclear island, including a simplified PRA*
  - *Definition of testing and analytical tools needed*
  - *Nominal interface requirements for power and support systems*
  - *Basic fuel cycle process flowsheets established by testing at reasonable scale*
  - *Pre-conceptual design of process facilities, with established pathways for disposal of all process waste streams*
  - *Simplified environmental impact statement for system*

R&D Challenge - R&D End Points (cont'd)

- *Performance Phase - Engineering-scale verification of process, phenomena, and material capabilities in prototypical conditions*
  - *Performance requirements and design information for nuclear island, sufficient for procurement specifications for construction of a prototype or demo plant*
  - *Probabilistic Risk Assessment*
  - *Demonstration of safety features through testing, analysis, experience*
  - *Validation of analytical tools*
  - *Conceptual design sufficient to show interface requirements for power and support systems*
  - *Fuel cycle process flowsheets validated at scale sufficient for commercial demonstration*
  - *Conceptual design of process facilities, with validated acceptability for disposal of all process waste streams*
  - *Environmental impact statement for system*

Numeric Scores

- *Concern with possible effect of combining the scores on the relative ranking of the systems and the width of the resulting figure of merit (for SU, SR, EC)*
- *Current approach assumes the criteria within a goal and the goals within a goal area are independent*
- *Assuming complete dependence - significantly wider distributions, with very irregular shapes*
- *Approaches are currently being compared and evaluated*
  - *Desirable outcome is to settle on a robust single figure for the rankings*
  - *Spread should mainly be a visual indication of the uncertainty about the potential of the system*

***CONCERN** - Excessive numerical manipulation of the evaluation results leads to undue emphasis on the score as the absolute selection determinant, with all other factors in the selection, including the expert discussions and evaluation justifications becoming a secondary matter*

R&D Prioritization

- *It is thought that a method to numerically rank the R&D items in order to develop the R&D plan is neither necessary nor desirable.*
- *The EMG expects to provide some guidance on how to use the information collected in the R&D Questionnaire in order to establish levels of importance or preference for the different R&D items.*
- *The EMG is seeking further guidance from the RIT on how far the Prioritization guidance needs to go.*
- *The resulting R&D Prioritization guidance will be incorporated in version 3 (March 4) of the Final Screening document*

Viability and Performance Evaluations

- The EMG started discussions on the methodology for the viability and performance evaluations during its meeting last month, January 10-11
- The areas for which a significantly modified or enhanced methodology will be required were identified and brief white papers on the future approach will be prepared as the starting point of the development. These areas include:
  - Method
  - SU3
  - SR2
  - SR3
  - EC
  - SU2
- The EMG will identify those areas in which R&D on the methodology will be necessary
- The RIT needs to define where the methodology R&D recommendations will be included in the Roadmap. Including them only as an addendum to the methodology appendix would not give them enough prominence.

BACKUP SLIDES

Consistency of Scores

- *Some inconsistencies in the preliminary scores are apparent:*
  - *Inconsistencies between TWGs*
  - *Inconsistencies in criteria scores for single system*
- *Crosscut Groups (and RIT) are the adequate channel for iterating with the TWGs and resolving the inconsistencies*
- *The EMG provides a set of items to ask in verifying consistency:*
  1. *Justification of the current scores, especially those that are very high or very narrow.*
     - *Write single most significant system attribute related to criterion*
  2. *Identification and documentation of assumptions that can lead to specific (high) scores.*
  3. *Identification and documentation of technology gaps that could result in large uncertainties in specific criteria*
     - *Summarize state of technology in simple terms, such as level of R&D required*
  4. *Ensure that the impacts of scores on one area over the other areas (i.e., implications of a high safety score on the economics goals) are properly addressed*
  5. *Ensure that development costs are consistent with assumptions and technology gaps*
  6. *Ensure that the whole system, not just the power plant, is included in the evaluations*
- *Based on the review of these items, the CGs or the RIT may pose specific questions on apparent inconsistencies to the TWGs.*